Nitrate Reduction — ChemDen™

Applications

- Treatment of nitrate wastes produced by
  - Chemical industry
  - Metal industry
  - Fertilizer manufacturing
  - Agriculture
  - Dairy farming
  - Mining
  - Defense industry
  - Nuclear power generation
  - Sewage treatment
- Decontamination of natural waters

Advantages

- Environmentally friendly
- Fast
- Performs at low temperature and ambient pressure
- Energy-efficient

Development Stage

- Demonstrated at bench and pilot scale
- Permits established and implemented at the Los Alamos Wastewater Treatment Plant with 75-liter batch scale treating wastewater containing on average 51 g/l of nitrate.

Status

- U.S. patent 6,030,520 Corresponding international protection filed in Canada, Japan, Korea, and Europe
- U.S. patent 6,436,275 International rights for this patent are not available

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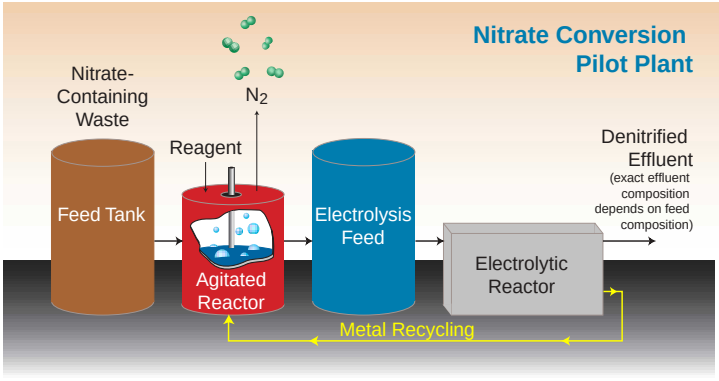
Los Alamos NATIONAL LABORATORY

The chemical, metal, mining, and farming industries all generate nitrate wastes that can harm humans and the environment if not disposed of properly. When nitrate waste contaminates a natural body of water, it causes excessive biological activity, vegetation growth, and precipitation of organic residue to the bottom. The decomposing residue in turn depletes oxygen from water, leading to the destruction of aquatic fauna and creating so called aquatic “dead zones.” Excessive nitrate concentrations can transform healthy bodies of water into decaying marshes. Nitrate contamination in drinking water can cause a toxic change in the blood (methemoglobinemia), which is especially detrimental to infants and nursing mothers. Nitrate can be separated from wastewater by physicochemical means such as reverse osmosis, ion exchange, electrodialysis, and evaporation, but these methods do not destroy the nitrates. The only commercially established method for nitrate destruction is biological degradation. However, biological treatment is limited by its slow reaction rates and inability to operate at high nitrate concentrations.

To address nitrate pollution, scientists at Los Alamos have developed a nonthermal and nonbiological process (ChemDen™) for converting nitrate waste into harmless nitrogen gas. The new method relies on transition metals and sulfamic acid to reduce the nitrates to nitrogen gas, which is released to the atmosphere. Experiments have shown that this method works effectively on a wide range of nitrate concentrations, from natural bodies of water containing low levels of nitrates to industrial wastewater high in nitrates. The process, which can operate continuously or in batches, is capable of reducing nitrates in highly concentrated waste streams containing up to 100 g/l of nitrate to a few parts per million. Solid nitrate salts, or heterogeneous solids containing nitrate salts, can be treated using the same method simply by mixing the salts with water. Because the process operates at ambient temperatures and pressures and the reaction rate is fast, the process is more cost effective than current nitrate treatment methods.

In addition to the chemical denitrification process, researchers have also developed a data analysis tool that assists ChemDen users with the preliminary process designs, including the calculation of applicable process parameters. This data analysis tool incorporates inputs such as waste stream concentrations, flow rates, and other application-specific data and may be helpful for developing process designs for ChemDen applications. The tool is also useful for calculating reaction kinetics and for performing process optimization for specific applications.



(Left) Diagram of nitrate conversion pilot plant system.

We are seeking an industrial partner to license and commercialize the process.

For partnership information:

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